

TRAVELING WAVE PUMPING OF ULTRA-SHORT PULSE X-RAY LASERS

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Pumping of proposed inner-shell photo-ionized (ISPI) x-ray lasers places stringent requirements on the optical pump source. We investigate these requirements for an example x-ray laser in Carbon lasing on the 2p-1s transition at 45 Å. Competing with this lasing transition is the very fast Auger decay rate out of the upper lasing state, such that the x-ray laser would self-terminate on a femtosecond time scale. Gain may be demonstrated if pump energy is delivered in a time short compared to the Auger rate. The fast self-termination demands that we sequentially pump the length of the x-ray laser at the group velocity of the x-ray laser. This is the classical traveling wave requirement and it imposes a condition on the pumping source that the phase angle of the pump laser be precisely de-coupled from the pulse front angle. At high light intensities, this must be performed with a vacuum grating delay line.

We will also discuss issues related to pump energy delivery, including, incident phase angle vs. x-ray conversion efficiency, pulse front curvature, temporal blurring and pulse fidelity. We will propose grating-mirror schemes that will satisfy these conditions. It is expected that these designs together with new high energy (>1J) ultra-short pulse (< 60 fs.) pump lasers now under construction, may fulfill our exacting pump energy conditions and produce a table-top x-ray laser.

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